A tunable beyond extreme ultraviolet source at 6.7 nm based on a laser produced plasma from a high Z mix

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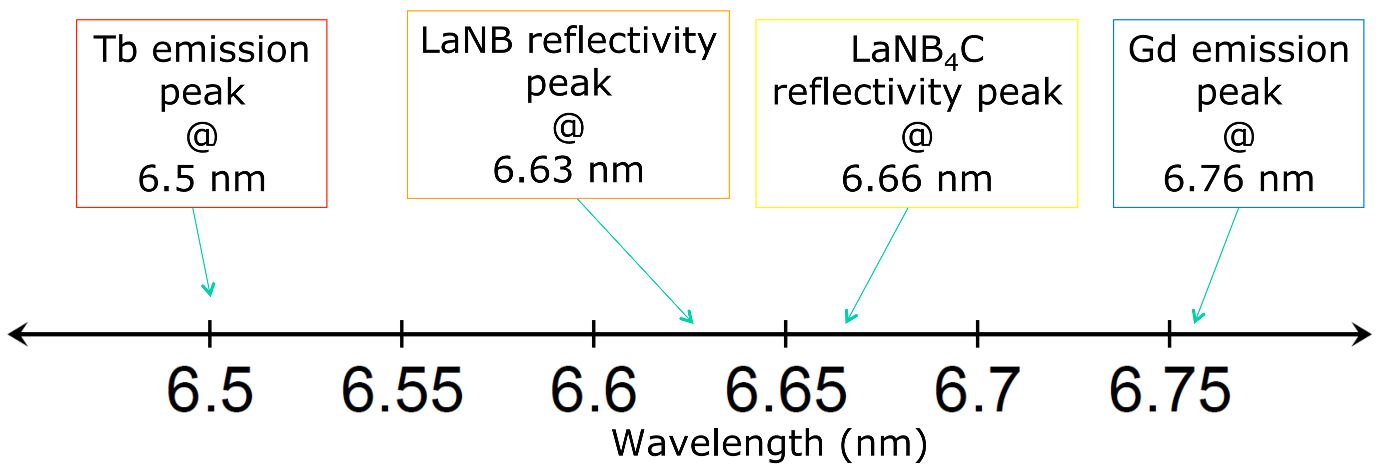

Figure 1: Wavelength peaks of plasma sources and multilayer mirrors around 6.x nm

1.Introduction

•Max multilayer mirror reflectivity peak lies between the emission peaks of Gd and Tb [1] – see figure 1

•Gd and Tb mix plasma could yield higher in band emission

•Wavelength tuning may be possible

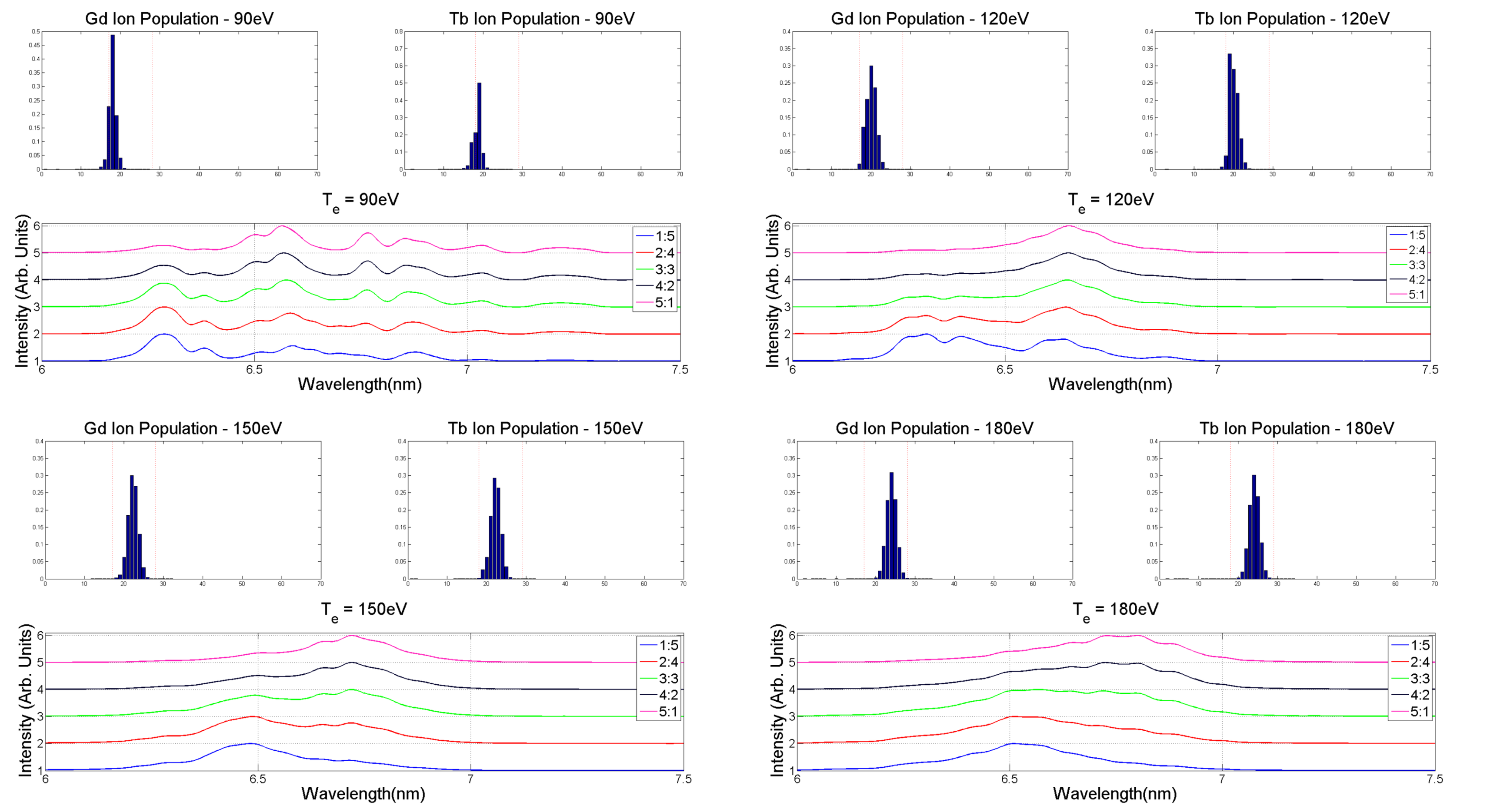

Figure 2: Theoretical emission from Gd/Tb mix plasmas at different electron temperatures and mixing ratios

2. Initial Calculations

•Cowan code [2] calculations weighted with a collisional radiative model [3] gives theoretical spectra at a given electron temperature

•Theoretical emission spectra from Gd and Tb plasma were combined to give emission of a mixed plasma

•Shows wavelength tuning capability

3. Experimental Setup

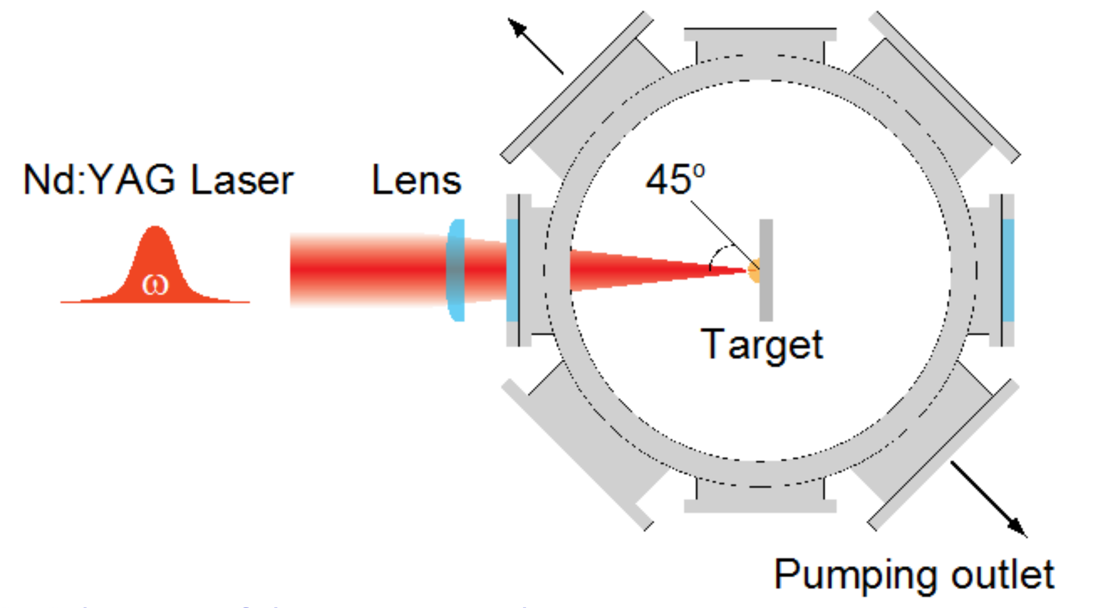

Figure 3: *Schematic of the experimental setup*

•A 150 ps (1064 nm) and 10 ns (1064 nm and 532 nm), Nd:YAG laser pulse with energy of 160 mJ and 300 mJ irradiated the target.

•Two target types were irradiated – solid Gd/Tb metals and 30% initial density form targets

•Emission spectra was recorded using a flat field grazing incidence spectrometer

•The time-integrated spectra were detected by a thermoelectrically cooled back-illuminated x-ray charge coupled device (CCD) camera

4. Experimental Results – Solid Target

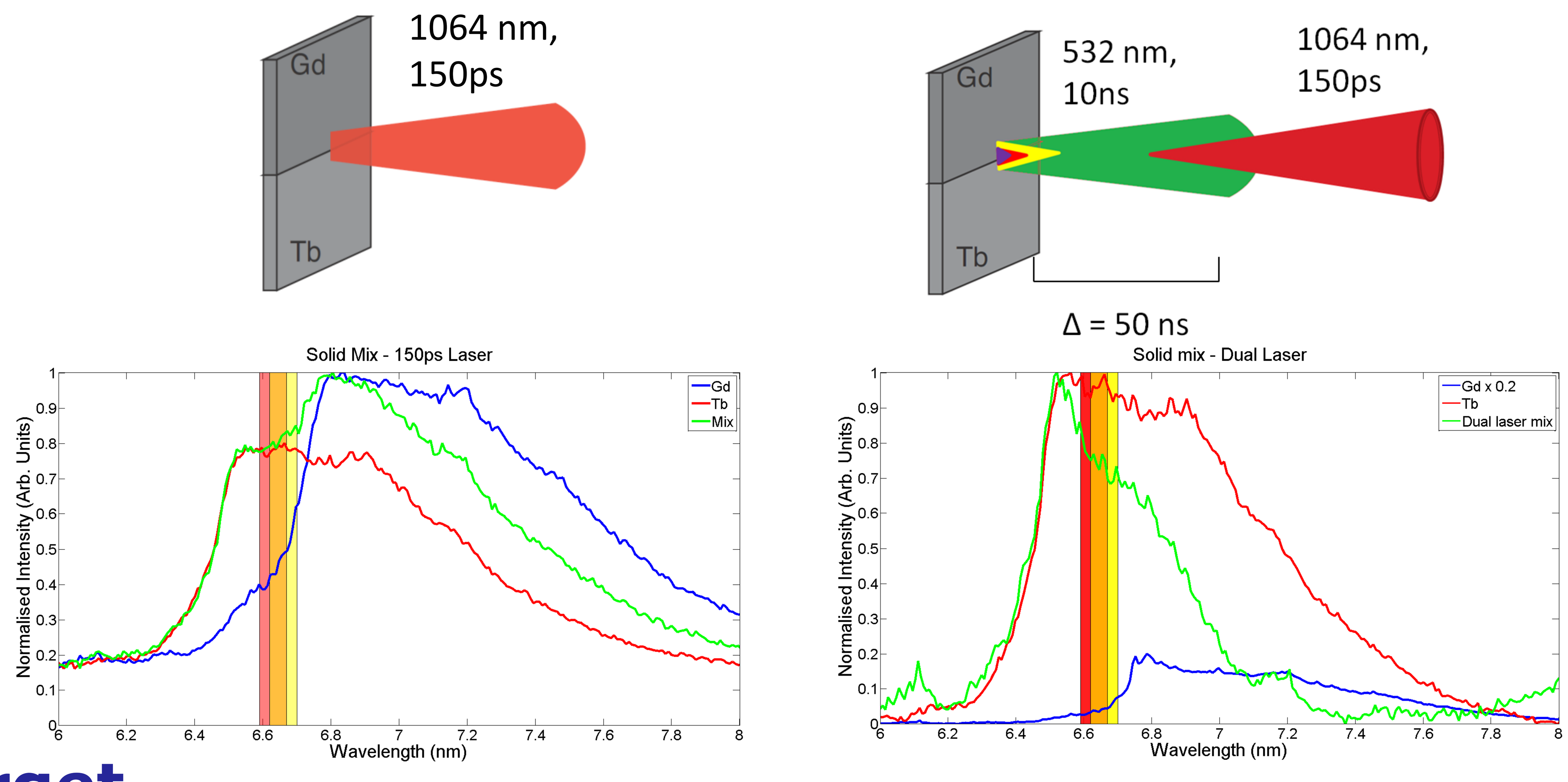

Figure 4: *Emission spectra from solid Gd, Tb and Gd/Tb mix plasma*

•The laser irradiated the target such that the focused laser spot was spread over both the Tb and Gd surface thus creating a plasma that contained both Tb and Gd material.

•Emission profile from the LPP created from the 150 ps laser shows higher inband when compared to pure Gd

•The dual laser plasma has a higher temperature, exhibiting higher emission at lower wavelengths from Tb ions

•There is high absorption at the longer wavelengths due to lower ion stages of Gd and Tb having high absorption cross sections in this wavelength region [4,5]

5. Experimental Results – Form Target

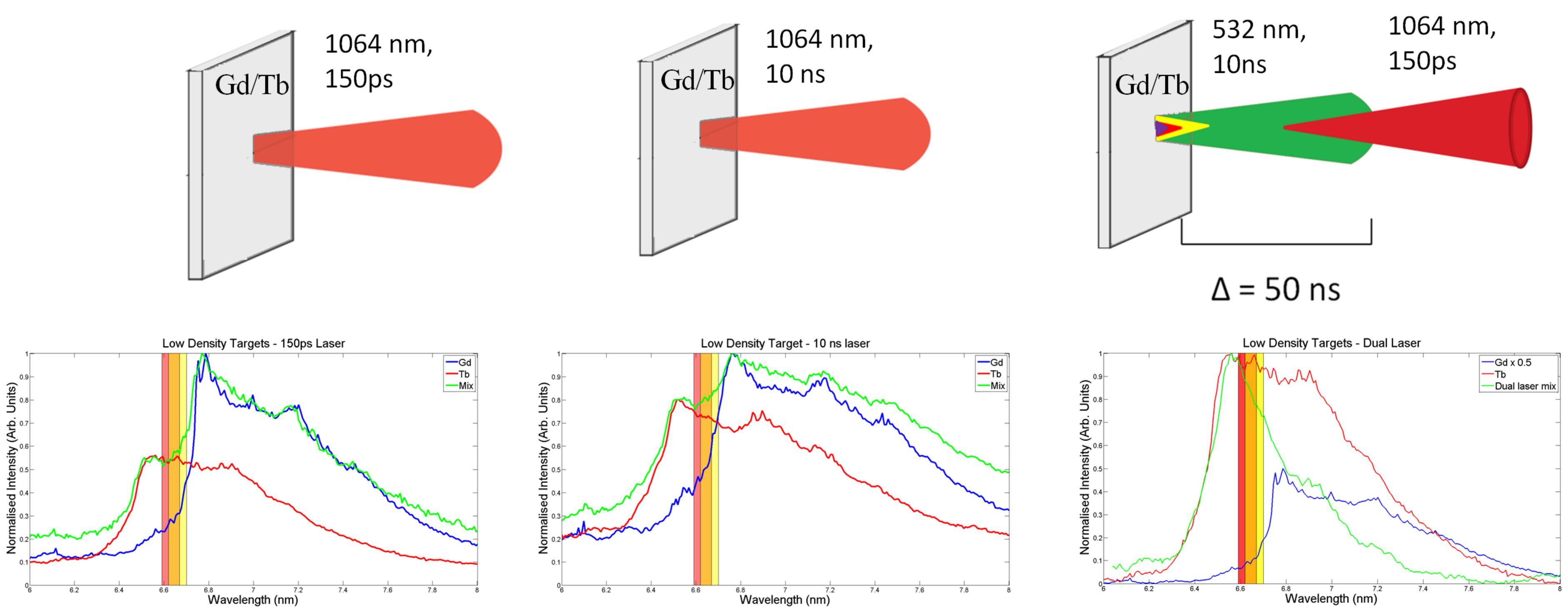

Figure 5: *Emission spectra from low density targets of Gd, Tb and Gd/Tb*

•The target has an initial density of 30% compared to pure Tb/Gd

•Similar results are seen as is the case of the solid target but with less absorption features due to a lower density plasma [6]

6. Future Work

•Varying of Gd:Tb mixing ratios to achieve wavelength "tunability"

•Measurement of absolute in-band intensity using a calibrated photo diode

7.References

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Acknowledgements: A part of this work was performed under the auspices of MEXT (Ministry of Education, Culture, Science and Technology, Japan) and "Utsunomiya University Distinguished Research Projects." One of the authors (T.H.) also acknowledges support The Canon Foundation and Research Grant (Basic Research) on TEPCO Memorial Foundation. The UCD group acknowledges support from Science Foundation Ireland under Principal Investigator Research Grant No. 07/IN.1/1771. We also are grateful to the Komatsu Corporation for providing the picosecond laser system.

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